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Incoming
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**From:** "Davis, Mike" <MDavis@archcoal.com>
**To:** <ogmcoal@utah.gov>
**CC:** <davedarby@utah.gov>, <jimdsmith@utah.gov>, "Hansen, Chris" <CHansen@arc...
**Date:** 3/30/2009 10:34 AM
**Subject:** Sufco 2008 4th Quarter Water Monitoring Data Submittal
**Attachments:** 2008 SUFCO monitoring letter for 4th quarter.pdf; FINAL Comparison of weath er and stream discharge for 2008.pdf

Sufco Mine has successfully uploaded all the Sufco mine 2008 4th quarter water monitoring data to the Division EDI site. The field parameter report and weather station and stream discharge data comparison report is attached.

If you have any questions, please send me an email or call me at (435) 286-4421.

Thanks,

Mike

PETERSEN HYDROLOGIC, LLC

26 February 2009

Mr. Mike Davis
Canyon Fuel Company, LLC
Sufco Mine
397 South 800 West
Salina, Utah 84526

Dear Mike,

This letter is to inform you that we have successfully completed the 4th quarter 2008 hydrologic monitoring at the SUFCO Mine. All of the regular monitoring sites were accessed and monitored. All water samples requiring chemical analysis have been submitted to SGS Laboratories in Huntington, Utah. The field parameters measured at each of the monitoring sites are listed on the attached sheet.

We appreciate the opportunity to provide this service to you. Please feel free to contact me if you have any questions in this regard.

Sincerely,

Erik C. Petersen, P.G.
Principal Hydrogeologist
Utah PG No. 5373615-2250

2695 N. 600 E. LEHI, UTAH 84043 (801) 766-4006

# PETERSEN HYDROLOGIC, LLC

| Station | Date | Time | Flow (gpm) | T (°C) | pH | Cond (µS/cm) | DO (mg/l) | Comments |
|---|---|---|---|---|---|---|---|---|
| SUFCO 001 | 21 Oct 08 | 14:45 | 0.16 | 8.8 | 7.41 | 470 | --- | System closed for winter. Sampled from free-flowing black pipe about 50 feet below spring box. |
| SUFCO 006 | 21 Oct 08 | 16:00 | 1.18 | 7.2 | 8.44 | 882 | 8.34 | |
| SUFCO 007 | 21 Oct 08 | 16:45 | 71 | 4.3 | 8.58 | 442 | 9.82 | |
| SUFCO 041 | 22 Dec 08 | 15:00 | 428 | 0.4 | 8.63 | 1,095 | 10.7 | |
| SUFCO 042 | 22 Dec 08 | 14:30 | 4,280 | 5.8 | 8.34 | 839 | 10.4 | |
| SUFCO 046 | 22 Dec 08 | 15:45 | 25.8 | 8.4 | 8.24 | 928 | 10.6 | |
| SUFCO 047 | 22 Dec 08 | 14:10 | 33.6 | 28.0 | 7.72 | 784 | --- | |
| SUFCO 047A | 22 Dec 08 | 15:30 | 81 | 4.8 | 7.80 | 1,456 | 9.74 | |
| SUFCO 057A | 21 Oct 08 | 15:10 | Dry | --- | --- | --- | --- | |
| SUFCO 089 | 7 Nov 08 | 16:40 | Dry | --- | --- | --- | --- | |
| SUFCO 090 | 8 Nov 08 | 13:45 | 0.304 | 0.5 | 7.56 | 263 | 7.05 | Flow measured about 40 feet below sanded-in flume on bedrock substrate. |
| GW-13 | 7 Nov 08 | 16:00 | 0.323 | 2.7 | 7.82 | 1,258 | --- | Lots of ice at the spring. |
| GW-20 | 8 Nov 08 | 14:50 | Dry | --- | --- | --- | --- | |
| GW-21 | 8 Nov 08 | 15:30 | 0.186 | 4.9 | 7.85 | 213 | --- | |
| USFS 109 | 8 Nov 08 | 14:35 | Dry | --- | --- | --- | --- | |
| USFS 110 | 8 Nov 08 | 14:30 | Dry | --- | --- | --- | --- | |
| FP-1 | 8 Nov 08 | 14:40 | No perennial flow in tributary | --- | --- | --- | --- | |
| FP-2 (East Fork) | 8 Nov 08 | 15:45 | No perennial flow in tributary | --- | --- | --- | --- | |
| Pines 100 | 8 Nov 08 | 15:45 | 0.225 | 3.7 | 7.50 | 336 | --- | Reported discharge is the sum of leakage from around the Pines 100 head box and water flowing to the roadside trough minus the amount discharging from GW-21 (which overflows into the Pines 100 discharge piping) |
| Pines 105 | 8 Nov 08 | 15:45 | Dry | --- | --- | --- | --- | |
| Pines 106 | 31 Oct 08 | 17:10 | Dry | --- | --- | --- | --- | Monitoring area covered with loose sand. |
| Pines 206 | 1 Nov 08 | 13:00 | 1.66 | 6.9 | 7.69 | 513 | --- | |
| Pines 209 | 1 Nov 08 | 13:45 | 6.41 | 6.3 | 7.77 | 401 | --- | |

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| Station | Date | Time | Flow (gpm) | T (°C) | pH | Cond (µS/cm) | DO (mg/l) | Comments |
|---|---|---|---|---|---|---|---|---|
| Pines 212 | 1 Nov 08 | 14:15 | 3.61 | 6.0 | 8.18 | 319 | --- | |
| Pines 214 | 31 Oct 08 | 14:00 | 0.42 | 5.1 | 8.25 | 588 | --- | Flow about 50 feet above rock ledge is 1.24 gpm. |
| Pines 218 | 8 Nov 08 | 14:20 | Dry | --- | --- | --- | --- | |
| Pines 219 | 8 Nov 08 | 14:10 | 0.16 | 4.6 | 7.39 | 150 | --- | |
| Pines 302 | 3 Nov 08 | 13:30 | Dry | --- | --- | --- | --- | Some dampness in bottom of stream channel, probably from yesterday's rain event. |
| Pines 303 | 31 Oct 08 | 16:20 | Damp soil only | --- | --- | --- | --- | |
| Pines 403 | 3 Nov 08 | 14:00 | 96 | 3.4 | 8.56 | 641 | 8.70 | Some rain in drainage yesterday |
| Pines 405 | 3 Nov 08 | 14:30 | 5,850 | 4.1 | 8.74 | 399 | 9.29 | |
| Pines 406b | 3 Nov 08 | 16:45 | 5,970 (our measurement) | 7.1 | 8.72 | 396 | 9.05 | USGS gauge is not operative |
| Pines 407 | 31 Oct 08 | 15:45 | 69 | 4.6 | 8.47 | 658 | 8.81 | |
| Pines 408 | 31 Oct 08 | 15:25 | 16.2 | 4.6 | 8.44 | 670 | 8.67 | |
| Pines 310 upper | 8 Nov 08 | 16:00 | 0.51 | 5.8 | 7.23 | 151 | --- | |
| Pines 310 lower | 8 Nov 08 | 16:05 | Dry | --- | --- | --- | --- | |
| Pines 311 | 8 Nov 08 | 15:50 | Dry | --- | --- | --- | --- | |
| US 79-13 | --- | --- | --- | --- | --- | --- | --- | Well not included in 4th quarter monitoring plan |
| US 80-2 | 21 Oct 08 | 14:20 | W.L. = 173.21 feet | | | | | |
| US 80-4 | --- | --- | --- | --- | --- | --- | --- | Well not included in 4th quarter monitoring plan |
| US 81-4 | 21 Oct 08 | 15:45 | W.L. = 948.44 feet | --- | --- | --- | --- | |
| 89-18-1 | 21 Oct 08 | 16:30 | Mined Through | --- | --- | --- | --- | |
| 89-20-1 | 21 Oct 08 | 16:30 | Mined Through | --- | --- | --- | --- | |
| 89-20-2W | 21 Oct 08 | 17:15 | W.L. = 147.72 feet | --- | --- | --- | --- | |
| WRDS B-3 | 22 Dec 08 | 17:40 | Dry | --- | --- | --- | --- | |
| WRDS B-5 | 22 Dec 08 | 17:10 | W.L. = 48.72 feet | --- | --- | --- | --- | There was only about 3 inches of water/mud in the bottom of the well casing, not enough to monitor. |
| WRDS B-6 | 22 Dec 08 | 17:00 | W.L. = 76.40 feet | 8.0 | 6.87 | 8,260 | --- | Note: additional length of well casing added to well during 2008. |
| WRDS B-8 | 22 Dec 08 | 16:20 | W.L. = 43.11 feet | 7.2 | 7.16 | 1,947 | --- | |

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# PETERSEN HYDROLOGIC, LLC

| Station | Date | Time | Flow (gpm) | T (°C) | pH | Cond (µS/cm) | DO (mg/l) | Comments |
|---|---|---|---|---|---|---|---|---|
| WRDS B-9 | 22 Dec 08 | 17:20 | Dry | --- | --- | --- | --- | |
| Link Portal West | 21 Oct 08 | 17:40 | No discharge | --- | --- | --- | --- | |
| Link Portal East Lower | 21 Oct 08 | 17:45 | No discharge | --- | --- | --- | --- | |
| Link 001 | 21 Oct 08 | 17:35 | Dry | --- | --- | --- | --- | |
| Link 002 | 21 Oct 08 | 17:50 | Dry | --- | --- | --- | --- | |
| 01-8-1 | 6 Nov 08 | 15:10 | W.L. = 1,778.44 feet | --- | --- | --- | --- | |
| M-SP01 | 7 Nov 08 | 14:15 | 0.510 | 5.7 | 7.23 | 784 | --- | System off for winter; measured from box overflow. |
| M-SP02 | 7 Nov 08 | 14:45 | Seep | 3.3 | 7.93 | 783 | --- | No outflow from spring box; seepage maintaining water in box (2.49 feet below top). |
| M-SP18 | 7 Nov 08 | 15:15 | 0.252 | 4.3 | 7.41 | 1,226 | --- | No water going into trough; we measured flow bypassing trough (running on ground about 10 feet below trough). |
| M-SP53 | 6 Nov 08 | 15:00 | 0.081 | 3.2 | 7.75 | 644 | --- | |
| M-SP08 | 6 Nov 08 | 16:40 | Dry | --- | --- | --- | --- | Spring pipe discharge area all frozen/ice. No discharge from pipe. |
| M-SP39 | 6 Nov 08 | 16:00 | 1.20 | 5.8 | 7.50 | 941 | --- | |
| M-STR04 | 6 Nov 08 | 16:30 | Dry | --- | --- | --- | --- | |
| EFB-1 | 8 Nov 08 | 20:00 | Dry | --- | --- | --- | --- | |
| EFB-2 | 8 Nov 08 | 19:50 | Dry | --- | --- | --- | --- | |
| EFB-3 | 8 Nov 08 | 19:40 | Dry | --- | --- | --- | --- | |
| EFB-4 | 8 Nov 08 | 19:30 | Dry | --- | --- | --- | --- | |
| EFB-5 | 8 Nov 08 | 19:20 | Dry | --- | --- | --- | --- | |
| EFB-6 | 8 Nov 08 | 19:00 | Dry | --- | --- | --- | --- | |
| EFB-7 | 31 Oct 08 | 13:20 | 5.03 | --- | --- | --- | --- | |
| EFB-8 | 31 Oct 08 | 13:40 | 9.38 | --- | --- | --- | --- | |
| EFB-8 Spring | 31 Oct 08 | 13:45 | 0.59 | --- | --- | --- | --- | |
| EFB-9 | 31 Oct 08 | 14:55 | 10.6 | --- | --- | --- | --- | |
| EFB-10 | 31 Oct 08 | 14:05 | 12.2 | --- | --- | --- | --- | |
| EFB-11 | 31 Oct 08 | 14:20 | 15.2 | --- | --- | --- | --- | |

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# PETERSEN HYDROLOGIC, LLC

| Station | Date | Time | Flow (gpm) | T (°C) | pH | Cond (µS/cm) | DO (mg/l) | Comments |
|---|---|---|---|---|---|---|---|---|
| EFB-11 spring | 31 Oct 08 | 14:30 | 0.42 | --- | --- | --- | --- | Flow about 50 feet above rock ledge is 1.24 gpm. |
| EFB-11A | 31 Oct 08 | 14:45 | Frozen/Inaccessible | --- | --- | --- | --- | |
| EFB-11B | 31 Oct 08 | 15:00 | 14.3 | --- | --- | --- | --- | |

**Note: All well water levels are reported in feet below the top of the inner well casing unless otherwise noted**

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# Comparison of Weather Data and Stream Discharge At the Sufco Mine During 2008

## Introduction

This report provides an analysis and discussion of the relationship between climatic variability and stream discharge rates in the Pines area at the Canyon Fuel Company, LLC, Sufco Mine during 2008. The information used in this analysis includes the information provided herein and information provided previously to the Utah Division of Oil, Gas and Mining.

## Climate Data

A weather station was installed in the upper East Fork of Box Canyon in August 2004. The station is fully automated and records precipitation and temperature data hourly during the ice-free period of the year. Because the tipping precipitation gage is not heated, precipitation falling as snow during cold periods of the year may not be included in the daily precipitation totals. During the winter season, the station is usually closed. Weather data from the East Fork weather station are available from mid-August 2004 to early November 2004, from mid-May 2005 to late October 2005, from late April to mid-October 2006, and from May 2007 to mid-November 2008. These data have been used in the flow comparisons presented below.

A National Weather Service weather station (Saline 24E) is also maintained near the Sufco Mine surface facilities. This weather station is operated year-round and records precipitation amounts (as direct rainfall or as snow-water equivalent). Information from this weather station is also used in the flow comparisons presented below. A plot of yearly precipitation at the Salina 24E for the period 1984 to 2008 as percentages of normal is presented in Figure 1.

The Palmer Hydrologic Drought Index (PHDI) has also been used in the flow comparisons presented below. A plot of the PHDI for Utah Region 4 is included in this analysis as Figure 2. The PHDI is a monthly numerical value generated by the National Climatic Data Center that indicates the severity of wet and dry spells. The PHDI is calculated from various hydrologic parameters including precipitation, temperature, evapotranspiration, soil water recharge, soil water loss, and runoff. Consequently, it is useful for evaluating the relationship between climatic conditions and groundwater and surface water discharge.

It is apparent in the plot of the PHDI that during the first half of 2008 the region (Utah Region 4) experienced a period of mostly near-normal to mildly wet conditions. During the second half of 2008, the region transitioned to a period of mild drought. It should be noted that the climatic conditions indicated in the PHDI for Utah Region 4 are calculated for a large region that includes most of central and south-central Utah. Additionally, because of the topographic setting and geologic conditions in the area, precipitation falling in the surrounding high-elevation mountainous areas is isolated from the Pines plateau area and

consequently does not contribute to groundwater recharge and surface-water flows in the Pines plateau area. Although regional climatic data are typically reflective of overall hydrologic conditions in the Pines area, measurements of precipitation falling in the local area is probably most useful in evaluating surface-water quantity and groundwater recharge rates. Locally, climatic data collected from the Salina 24E station during 2008 (Figure 1) indicates somewhat dryer conditions for the Sufco Mine area than that suggested by the regional climatic data. Precipitation measured at the Salina 24E station during 2008 was the lowest ever measured at the station (with 24 years of record). The annual precipitation measured at the station during eight of the last nine years has been below the station average, and each of the past three years has been dryer than the year preceding it, clearly indicating drought conditions in the area (Figure 1).

Precipitation measured at the East Fork weather station during the 7-month period from April through October 2008 was also meager and reflective of drought conditions; totaling only 5.18 inches (see attached Sufco East Fork weather station data and graphs on Figures 4 and 6).

***Pines 407***

Pines 407 is a surface-water monitoring station on the Main Fork of Box Canyon Creek just above the confluence with the East Fork of Box Canyon (see Figure 3 for location). Discharge data are measured at Pines 407 using a 3-inch Parshall flume that is installed at the site. Flow measurements during the ice-free period are recorded using an electronic pressure transducer and data logger assembly installed at the flume. The site is inspected and

monitored quarterly and a manual flow measurement is performed. Discharge data at Pines 407 for 2008 are plotted together with temperature and precipitation data from the East Fork Weather Station and the PHDI for Utah Region 4 on Figure 4. Additionally, for the purposes of comparison, discharges from Pines 407 and Pines 408 are plotted together with a plot of the PHDI for Utah Region 4 for the period 2000-2008 in Figure 5.

The largest discharge measured at Pines 407 during 2008 took place on 28 April 2008 during a monitoring event that occurred early in the year because of a lack of snow cover (Figure 6). The discharge measured at that time (148 gpm) was the largest measured at the site in more than five years, and apparently not reflective of the drought conditions that prevailed at the site during 2008. This is attributable to the fact that such early season monitoring events have not been performed at the site because it does not usually become reasonably accessible until later in the season. The discharges measured at Pines 407 later during 2008 were generally similar to those measured during 2007 and somewhat lower than those measured in 2006, which is reflective of the overall drought conditions prevailing at the Box Canyon Creek drainage in the past three years (Figure 5). As is typical in Sufco Mine area drainages, discharge in Box Canyon Creek increased in the late fall as temperatures and sunlight hours decreased, vegetation became dormant, and corresponding decreases in evapotranspiration occurred. Although of different magnitude, overall discharge trends observed at Pines 407 in Box Canyon Creek during 2008 were similar to those observed at Pines 408 in the East Fork (Figure 5). This supports the conclusion that the discharge variability monitored at Pines 407 during 2008 is a reflection of climatic effects.

*Pines 408*

Pines 408 is a monitoring station on the East Fork of Box Canyon Creek just above the confluence with the main fork of Box Canyon Creek (see Figure 3 for location). Discharge data are measured at Pines 408 when accessible using a 3-inch Parshall flume that is installed at the site. Flow measurements during the ice-free period are recorded using an electronic pressure transducer and data logger assembly installed at the flume. The site is inspected and monitored quarterly and a manual flow measurement is performed. During an intense thunderstorm runoff event in the East Fork drainage on 27 July 2008, the Parshall flume at Pines 408 was washed out and transported away from the monitoring site. The pressure transducer and data logger were not recovered. Consequently, discharge measurements for a period of time during the summer were not available during 2008. Discharge data at Pines 408 for 2008 are plotted together with temperature and precipitation data from the East Fork Weather Station and the PHDI for Utah Region 4 in Figure 6. Additionally, for the purposes of comparison, discharges from Pines 407 and Pines 408 are plotted together with a plot of the PHDI for Utah Region 4 for the period 2000-2008 in Figure 5.

The largest discharge measured at Pines 408 during 2008 occurred on 28 April 2008 during a monitoring event that took place early in the year because of a lack of snow cover (Figure 6). The discharge measured at that time (36.9 gpm) was relatively high and apparently not reflective of the drought conditions that prevailed at the site during 2008 (Figure 5). This is attributable to the fact such that such early season monitoring events are not typically performed at the site because it does not usually become reasonably accessible until later in the season.

The discharges measured at Pines 408 later during 2008 were generally similar to those measured during 2007 and somewhat lower than those measured in 2006, which is reflective of the overall drought conditions prevailing at the Box Canyon Creek drainage in the past three years (Figure 5). As is typical in Sufco Mine area drainages, discharge in Box Canyon Creek increased in the late fall as temperatures and sunlight hours decreased, vegetation became dormant, and corresponding decreases in evapotranspiration occurred. Although of different magnitude, overall discharge trends observed at Pines 408 in The East Fork of Box Canyon Creek during 2008 were similar to those observed at Pines 407 in the main fork of Box Canyon Creek (Figure 5). This supports the conclusion that the discharge variability monitored at Pines 408 during 2008 is a reflection of climatic effects.

***FP-1***

FP-1 is a monitoring site on a specified reach of the stream channel in the upper west fork of the Main Fork of Box Canyon located between monitoring sites SUFCO 089 and GW-20 (See Figure 3). Monitoring at FP-1 occurs on or near October 1 of each year. Monitoring at FP-1 consists of the identification of the location of the first (uppermost) discharge in the stream on that date. A discharge measurement is also performed at this location. On 8 November 2008 there was no flow in the FP-1 stream section. Discharge was also not present in the stream reach when observed on 18 September 2008.

The first occurrence of continuous flow in the main fork of Box Canyon Creek on 8 November 2008 occurred at an approximate location as shown on Figure 3. A discharge of

0.304 gpm was measured at that time in the creek a short distance downstream. At locations higher in the stream drainage, zones of intermittent wetness were present.

***FP-2***

FP-2 is a monitoring site on a specified reach of stream in the North Water Canyon tributary of the East Fork of Box Canyon Creek between Pines 105 and the confluence with the East Fork of Box Canyon Creek (See Figure 3 for location). Monitoring at FP-2 occurs on or near October 1 of each year. Monitoring at FP-2 consists of the identification of the location of the perennial portion of the stream. There was no perennial stream flow at the confluence with the East Fork of Box Canyon Creek when the site was visited on 31 October 2008. Discharge was also not present in the stream reach when observed on 12 September 2008.

***Pines 106***

Pines 106 is a monitoring location in Sufco's quarterly water monitoring plan. Pines 106 is located at the approximate location of site EFB-6, which is a flow-only monitoring site on the East Fork of Box Canyon Creek added to the monitoring plan in conjunction with the undermining of the stream with the 3 Left Pines East longwall panel. The location of Pines 106 is approximately coincident with the historical uppermost occurrence of perennial flow in the East Fork of Box Canyon Creek. Above this location, the stream is usually dry. Discharge at Pines 106/EFB-6 is plotted in Figure 7. Discharge at monitoring site EFB-7, which is located on the East Fork a short distance below Pines 106/EFB-6 is also plotted on Figure 7. Typically, discharge in the East Fork increases rapidly through diffuse seepage from the underlying sandy substrate between Pines 106/EFB-6 and EFB-7. Also plotted

together with the discharge measurements in Figure 7 is a plot of precipitation data from the Salina 24E weather station. The yearly precipitation data are plotted on Figure 7 as deviations from the long-term (24 year) average precipitation.

It is apparent in Figure 7 that discharge near Pines 106 was meager during 2008. Although wetness was present near Pines 106 during early 2008, later in the year appreciable stream flow in the creek started near the EFB-7 location. The downward movement of the location of the first perennial discharge in the East Fork of Box Canyon Creek may be related to subsidence effects associated with mining in the underlying 4 Left Pines East longwall panel. However, the fact that appreciable stream discharge still occurs a short distance below EFB-6 demonstrates that the surface water has not been diverted away from the site or into deep rock strata underlying the creek.

It is apparent in the plot of discharge from EFB-7 and Pines 106/EFB-6 (Figure 7) that discharge in the drainage at EFB-7 continued during 2008 at levels not inconsistent with those anticipated for the prevailing climatic (drought) conditions in the area during 2008 (as evidenced by the plots of yearly precipitation at the Salina 24E station in the Sufco permit area as shown in Figures 1 and 7).

### *USFS 109*

USFS 109 is routinely monitored as part of Sufco's quarterly water monitoring program. The site is located in the upper middle fork of the Main Fork of Box Canyon. There was no discharge measured during 2008 at USFS 109.

*USFS 110*

USFS 110 is routinely monitored as part of Sufco's quarterly water monitoring program. The site is located in the upper main fork of Box Canyon Creek. There was no discharge measured during 2008 at USFS 110.

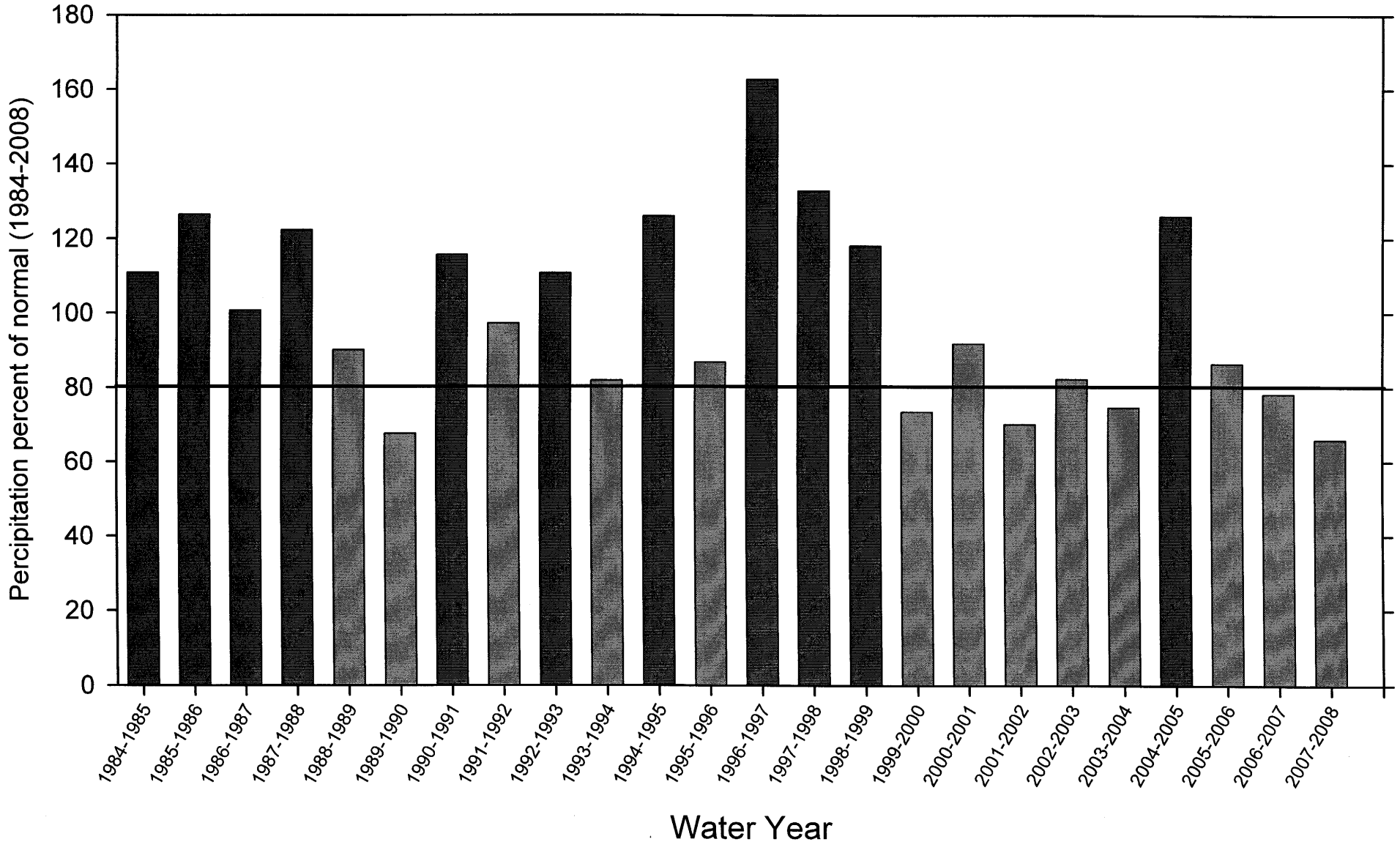
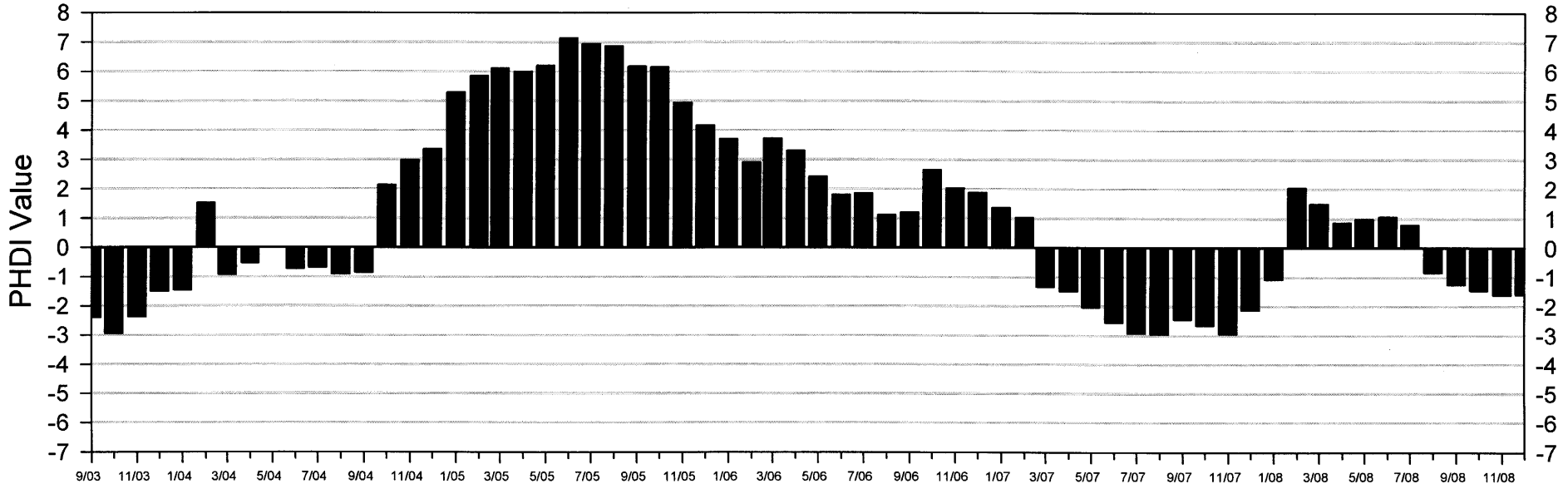



Figure 1 Sufco Mine Weather Station Precipitation




-1 to -2 Mild Drought
-2 to -3 Moderate Drought
-3 to -4 Severe Drought
-4 to -5 Extreme Drought

1 to 2 Mild Wet Spell
2 to 3 Moderate Wet Spell
3 to 4 Severe Wet Spell
4 to 5 Extreme Wet Spell

Figure 2 Plot of Palmer Hydrologic Drought Index for Utah Region 4.

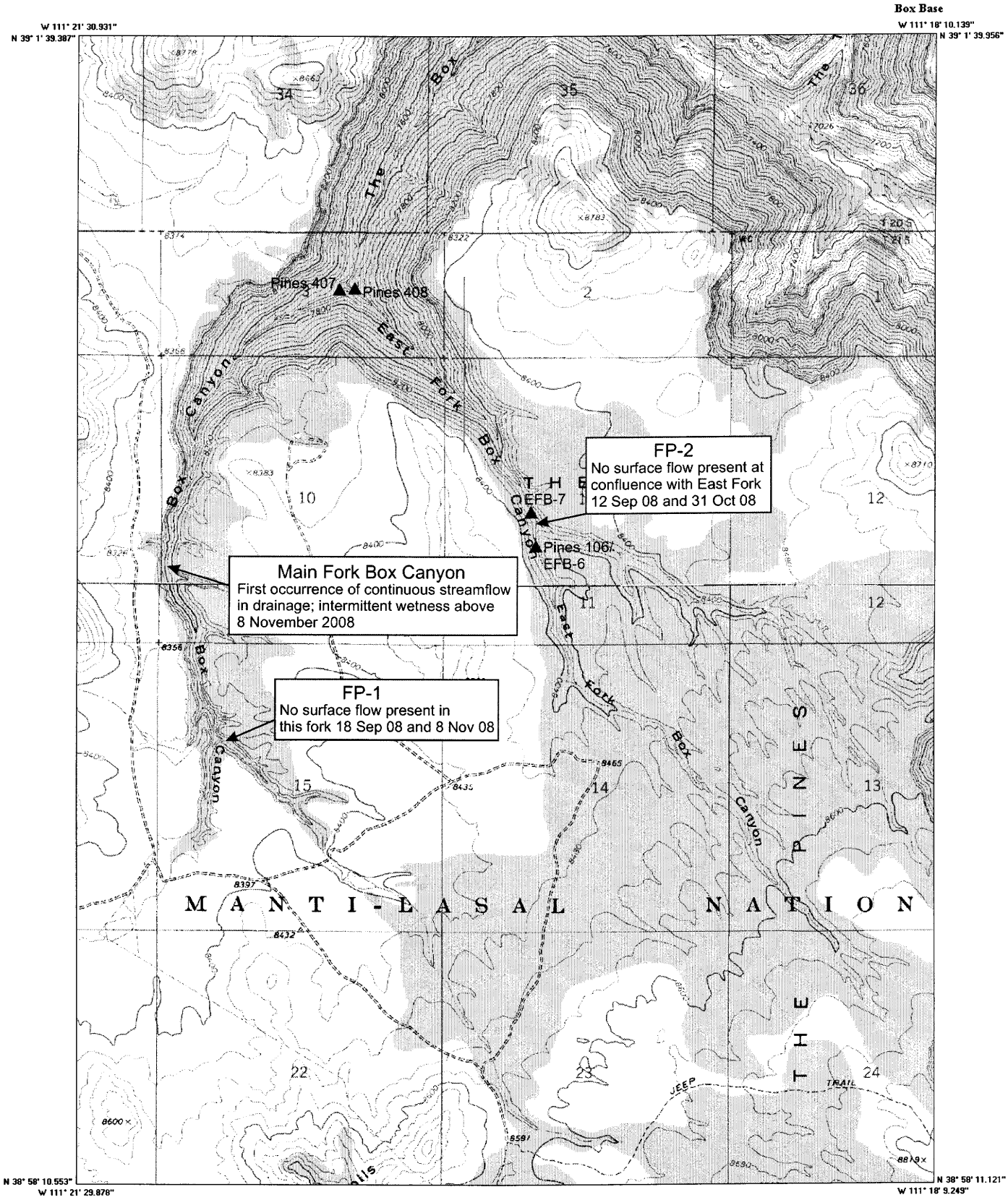



Figure 3 Stream locations.

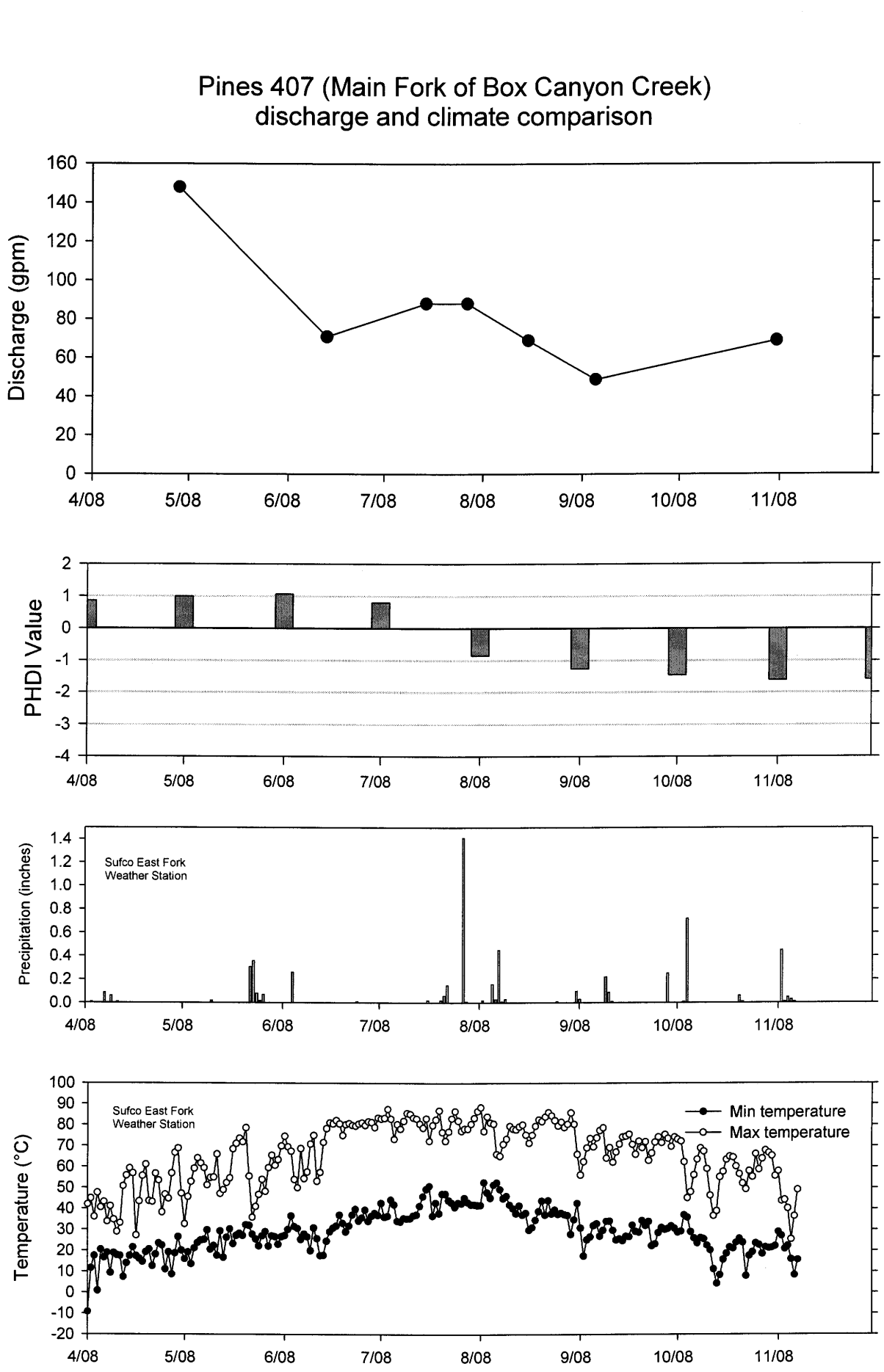



Figure 4 Pines 407 discharge and climate comparison.

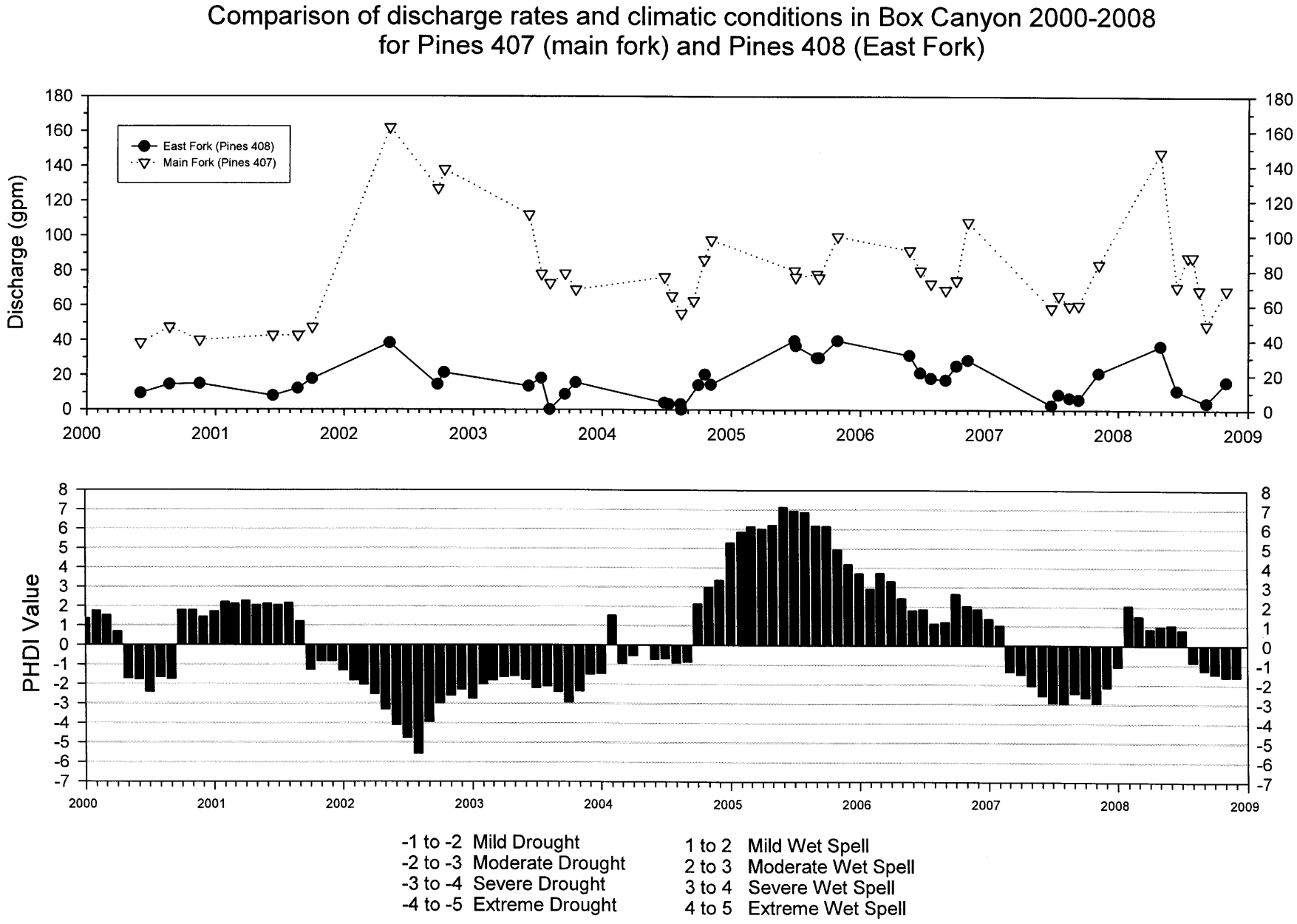



Figure 5 Discharge hydrographs for Pines 407 and Pines 408 and PHDI for Utah Region 4.

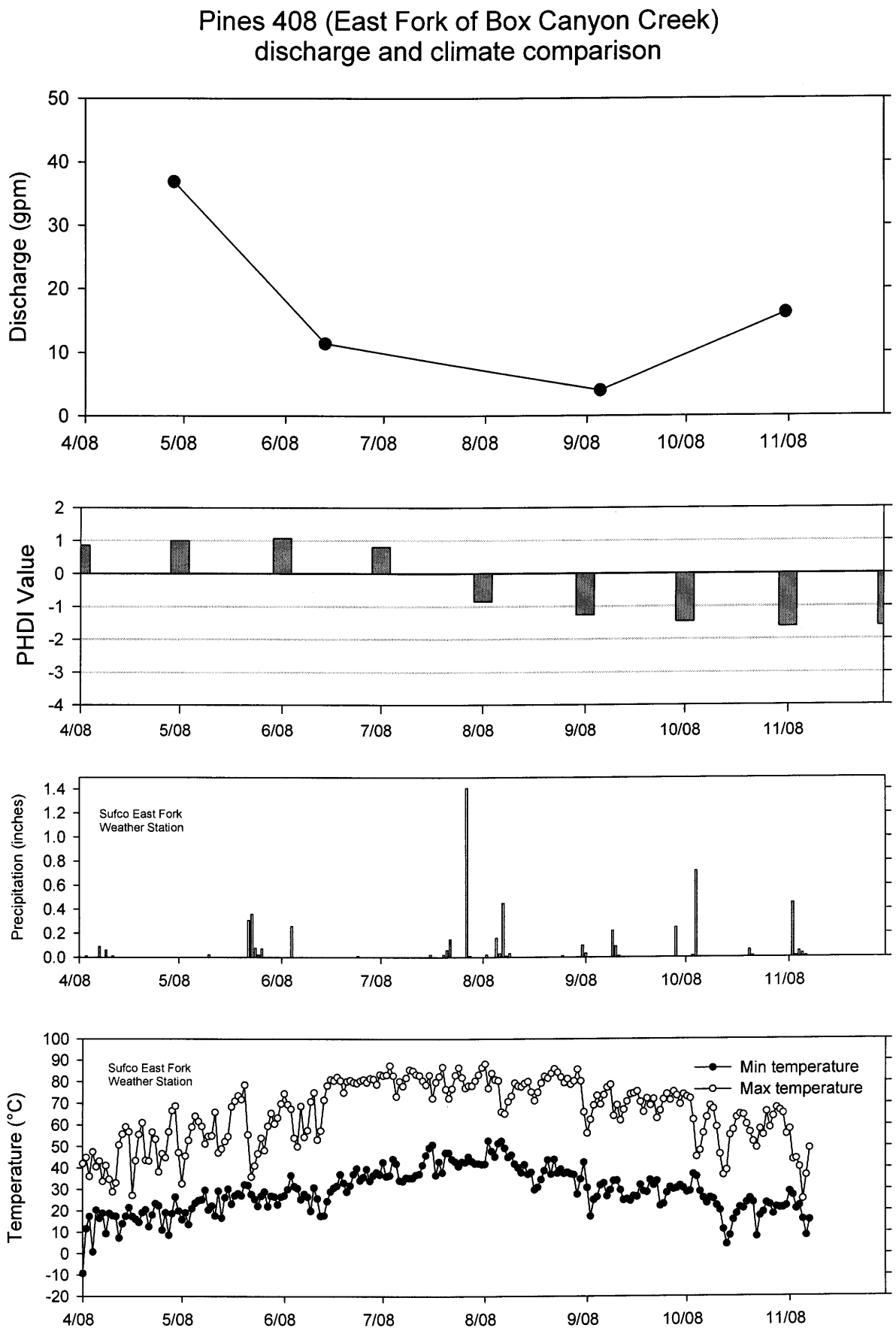



Figure 6 Pines 408 discharge and climate comparison.

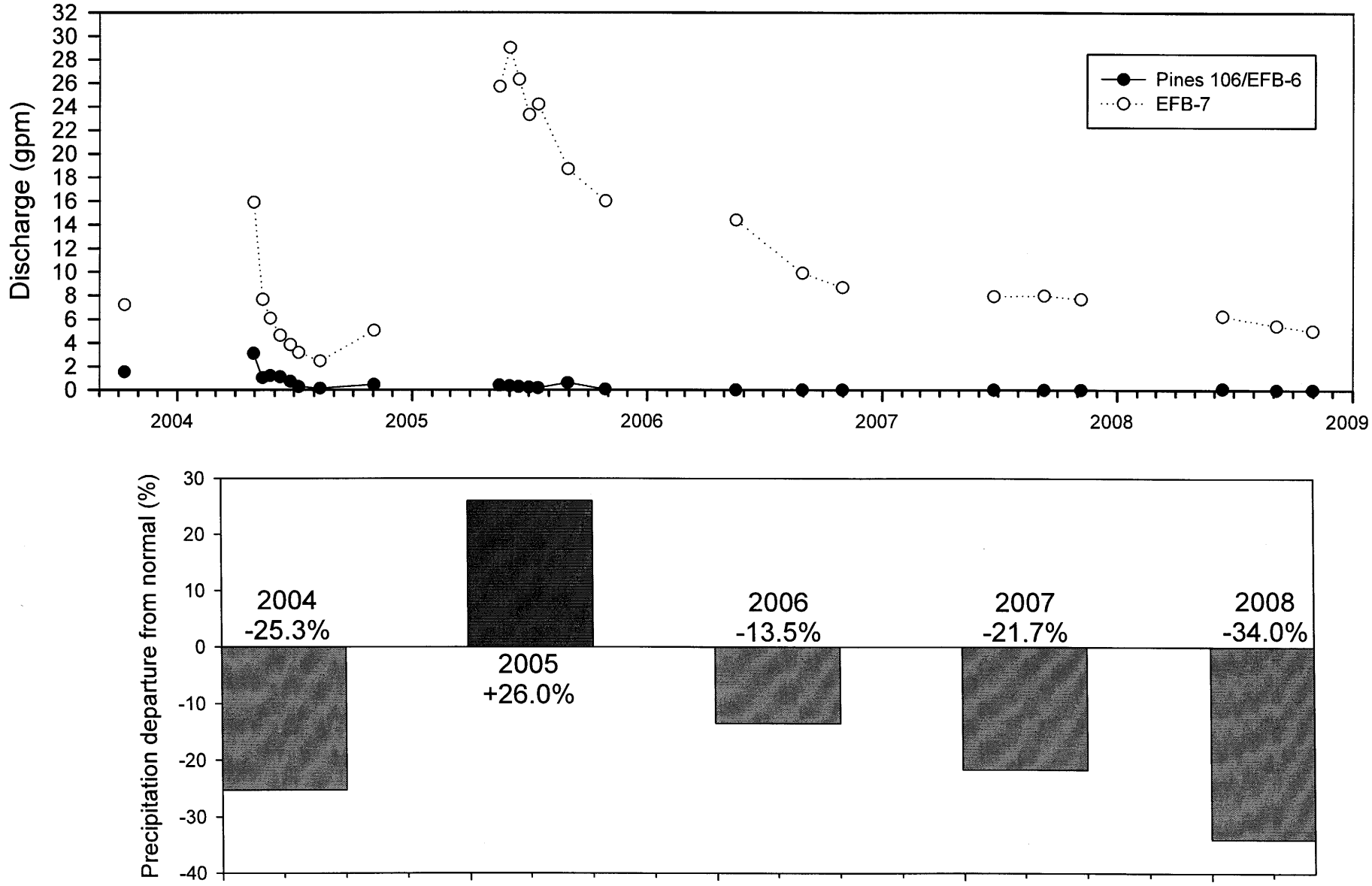



Figure 7 Pines 106/EFB-6 and EFB-7 discharge and Sufco Mine weather station data 2004-2008.